

# How peritectic phases affect the critical element concentration of peraluminous melts during biotite-dehydration melting of metapelites

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Elements – such as Li, Be, Sn, Cs, Ta and W, which are critical for the green energy transition – are mined from peraluminous granites and granitic pegmatites that involve crustal melting of metapelitic protoliths [1]. Most previous studies have suggested that magmatic or sedimentary processes – e.g., extreme fractional crystallisation, multiple melt extraction, and protolith enrichment – control the genesis of such deposits [2, 3]. Recently, partial melting temperatures or reactants (biotite or muscovite) have also been suggested to play a role [4,5].

This contribution focuses on biotite-dehydration melting, which typically also involves feldspars, quartz and aluminosilicates as reactants and two main peritectic phases: garnet at higher P and/or high bulk Fe/Mg ratio and cordierite at lower P and/or low bulk Fe/Mg; co-existing at intermediate values. The literature shows micas host all the elements of interest [4], whereas cordierite hosts Li and Be [6]. Hence, it is expected that partial melting reactions at lower pressures will produce melts depleted in Li and Be, but no studies so far demonstrate how depleted.

To investigate the role of peritectic phases, we compare the critical element concentrations of melts formed by the biotite-dehydration melting at 4 kbar and 8 kbar. For the trace element modelling, we used phase relations calculated with thermodynamic modelling (Perple\_X) of an average pelite and partition coefficients extracted from experiments at lower pressures and calculated from natural samples at 8 kbar. We then compare the modelled results with examples from the European Variscides for which we have acquired LA-ICP-MS trace element concentrations of cordierite, biotite and garnet and leucosome bulk-rock analyses. This allows us to not only study the influence of different peritectic phases on the critical element budget of peraluminous melts but also to assess the validity of the existing partition coefficients for these critical elements.

[1] Linnen et al. (2012), *Elements* 8, 275-280.

[2] Tichomirowa et al. (2019), *Minerals* 9, 769.

[3] Romer & Kroner (2016), *Gondwana Research* 32, 60-95.

[4] Kunz et al. (2022), *Geology* 48, 967-960.

[5] Zhao et al. (2022), *Geology* 50, 121-125.

[6] Bertoldi et al. (2004), *Lithos*, 78, 389-409.